

# NASA TECH BRIEF



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## Digital Filter Synthesis Computer Program

A digital filter synthesis computer program has been developed to express any continuous function of a complex variable in approximate form as a computational algorithm or difference equation.

Given an analog prototype of the desired filter and a sampling interval, analog filter critical frequencies are computed along with a new frequency-scaled filter function,  $F(s)$ , which is the transfer function for the real-time analog equivalent network.

The bilinear transform method is used on  $F(s)$  to make the transformation from the  $s$  to the  $z$  plane. The resulting function  $F(z)$ , is the digital equivalent of a transfer function and can be represented by the expression

$$Fz = \frac{\sum A_n z^{-n}}{\sum B_n z^{-n}} = \frac{O(z)}{I(z)}$$

where  $O(z)$  is the output data function of  $z$ ,  $I(z)$  is the input data function of  $z$ , and  $A_n$  and  $B_n$  are, respectively, the numerator and denominator coefficients of the digital transfer function.

Solving for the function  $O(z)$ , which represents the desired output digital data list, the program obtains the difference equation that represents the nearest digital equivalent to the analog prototype within the

limitations allowed. The coefficients,  $A_n$  and  $B_n$ , of this difference equation are listed for each filter configuration.

Once the difference equation has been developed, digital filtering can be performed by the program on any input data list.

### Notes:

1. This program is written in Fortran IV for use with the IBM 7090/94 computer with IBSYS Executive monitor.
2. This program has broad general application and a particular usefulness in the computer simulation studies of space instrument systems.
3. Inquiries concerning this program may be directed to:

COSMIC  
Computer Center  
University of Georgia  
Athens, Georgia 30601  
Reference: B68-10164

### Patent status:

No patent action is contemplated by NASA.

Source: Robert M. Munoz and Richard A. Moyer  
Ames Research Center  
(ARC-10130)

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